

CLAIMS

What is claimed is:

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5 1. A device for obtaining an accurate thermal profile of a semiconductor device during processing, said device comprising:
a packaging substrate;
a semiconductor die being positioned on said packaging substrate; and
a thermocouple positioned between said substrate and said die.

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2. A device as in Claim 1, wherein said thermocouple is secured in place between said substrate and said die using an adhesive.

3. A device as in Claim 2, wherein said adhesive comprises an epoxy.

5 4. A device as in Claim 1 wherein said semiconductor die includes an active circuit surface having electrically conductive bumps formed thereon and said packaging substrate includes a plurality bonding pads formed on a surface thereof, said semiconductor die being positioned on said packaging substrate such that said electrically conductive bumps are in electrical contact with said plurality bonding pads.

5. A device as in Claim 4, wherein said packaging substrate and said semiconductor die are secured in place by a solder bond between said electrically conductive bumps and said plurality of bonding pads, said bond securing said thermocouple in position between said packaging substrate and said semiconductor die.

5 6. A device for obtaining an accurate thermal profile of a semiconductor device during processing, said device comprising:
a packaging substrate having a first surface and a second opposite surface;
said first surface including at least one bonding pad;
a semiconductor die being secured to said at least one bonding pad;

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said packaging substrate having an opening in said second opposite surface;
and
a thermocouple positioned inside said opening and secured in place.

7. A device as in Claim 6, wherein said opening in said second opposite surface passes through said first surface and said bonding pad.

8. A method of constructing a device for accurately measuring the temperature of a semiconductor device at an interface between a semiconductor die and a packaging substrate, the method comprising the steps of:

- a. providing a semiconductor die, said die including an active circuit surface having electrically conductive bumps formed thereon;
- b. removing said bumps from said semiconductor die;
- c. providing a packaging substrate, said substrate including a first surface for receiving said semiconductor die and an opposite second side;
- d. providing a thermocouple; and
- e. securing the active surface of said die to the first surface of said substrate such that said thermocouple is positioned between the active surface of said die and the first surface of said substrate.

9. A method as in Claim 8, wherein said step e), of securing said thermocouple between said die and said first surface, includes the steps of:

- i) treating said thermocouple with epoxy;
- ii) contacting the epoxy treated thermocouple to the active surface of said die;
- iii) contacting the epoxy treated thermocouple and the active surface of said die to the first surface of said substrate such that said thermocouple is positioned between the active surface of said die and the first surface of said substrate;
- iv) clamping said thermocouple in place between the active surface of said die and the bonding pad;
- v) curing the epoxy; and

- vi) securing said die, said thermocouple, and said substrate in place by soldering said die to said substrate.

10. A method as in Claim 9, wherein said step iv), of clamping said thermocouple between said die and said first surface of said packaging substrate, includes the steps of:

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- A. providing a stiffener sized to securely fit around said die, said stiffener including a passage sized to pass said thermocouple through said passage;
- B. positioning said stiffener on said first surface of said packaging substrate such that the stiffener fits around said die and allows said thermocouple to fit through the passage;
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- C. providing a heat spreader;
- D. clamping said heat spreader in position on said stiffener such that said die, said stiffener, and said thermocouple are all held in place while said epoxy cures; and
- E. after curing the epoxy, removing the heat spreader and the stiffener, leaving the thermocouple epoxied in place between the substrate and die.

11. A method as in Claim 8, wherein said step e), of securing said thermocouple between said die and said first surface of the packaging substrate, includes the steps of:

i) placing said die on the first surface of said substrate such that the electrically conductive bumps of said die are in contact with a plurality of bonding pads formed on said first surface of said substrate; and

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ii) reflowing said electrically conductive bumps such that said bumps are secured to said plurality of bonding pads of said substrate to secure said die in place;

iii) forming an opening in said second side of said substrate, said opening passing through said substrate enabling contact with the active circuit surface of said die;

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iv) urging said thermocouple into contact with the active surface of said die by inserting said thermocouple into said opening;

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- v) filling said opening with an epoxy to secure said thermocouple; and
 - vi) curing the epoxy.